CATALYST
HANDBOOK

WITH SPECIAL REFERENCE TO
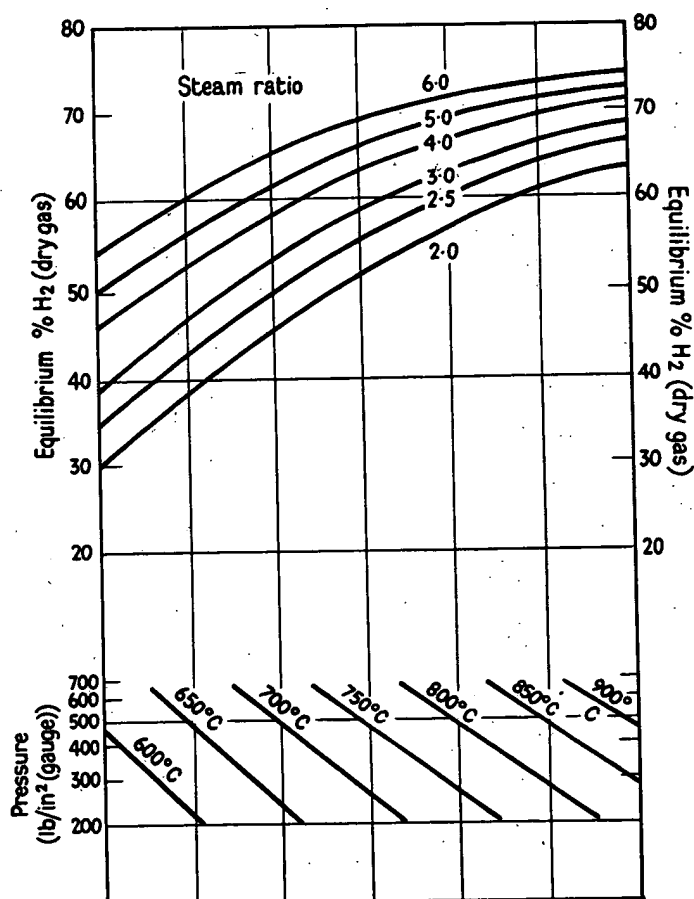UNIT PROCESSES IN AMMONIA
AND HYDROGEN MANUFACTURE

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FIG. 35. Equilibrium concentration of hydrogen as a function of temperature, pressure, and steam ratio for naphtha.

Heats of reaction

The enthalpy change for the steam-reforming reaction varies with the reaction conditions.

The methane–steam reaction is always endothermic, as demonstrated by consideration of the reactions

$$CH_4 + H_2O \rightleftharpoons CO + 3H_2 \qquad \Delta H_{25^\circ C} = +49 \cdot 2 \text{ kcal/mole}$$

$$CH_4 + 2H_2O \rightleftharpoons CO_2 + 4H_2 \qquad \Delta H_{25^\circ C} = +39 \cdot 4 \text{ kcal/mole}$$

Typical heats of reaction are given below in Fig. 36 for the naphtha–steam reaction proceeding to equilibrium under conditions of practical interest for naphtha $CH_{2 \cdot 2}$.

The reaction is most endothermic at the limit when the whole of the carbon is reformed to give oxides of carbon together with hydrogen and becomes less